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LONG-RANGE ICE OUTLOOK EASTERN ARCTIC (1964)

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ABSTRACT

An outlook of expected sea ice conditions in the eastern North American Arctic is presented for the period mid-May through mid-August 1964. Oceanographic and climatic data for the Eastern Arctic were analyzed in terms of sea ice growth during the past winter. These analyses, combined with observed ice conditions for the period 5 through 8 April 1964, and a comprehensive study of historical ice and climatic information formed the basis for the 1964 Ice Outlook. Evaluation of this information indicates that present ice conditions in the Labrador Sea and along the Newfoundland Coast are similar to those observed in 1959. Anomalous heavy ice observed in Baffin Bay precluded establishment of an analogous year for that area, although the North Open Water development resembled that of 1959. Goose Bay, Sondre Stromfjord, and Kulusuk are expected to open for escorted shipping slightly earlier than normal, whereas Thule and Itivdleq are expected to open later than normal.

In terms of the 1963 ice season, it is expected that Thule, Sondre Stromfjord, and Kulusuk will open about the same time as last year, whereas Goose Bay will open about 2 weeks earlier than in 1963. Lack of an accurate 1963 opening date for Itivdleq precludes determination of a similar date for that site.

CONTENTS

LONG-RANGE ICE OUTLOOK EASTERN ARCTIC (1964)

I. INTRODUCTION

The Long-Range Ice Outlook for 1964 presents a written and graphic description of the expected ice conditions during the forthcoming operations of the Military Sea Transportation Service (MSTS) in the eastern Arctic. Prognostic monthly ice charts showing the expected distribution of sea ice from mid-May through mid-August are presented.

Although a comprehensive ice survey was made from 5 through 8 April, the outlook is basically a historical and statistical approach to the problem of predicting long-range ice conditions. Initially, an evaluation of the oceanographic and climatic conditions affecting ice formation, growth, and drift during the past winter is made. A comparison is then made between these environmental conditions and similar historical data in conjunction with the severity of ice conditions experienced during the disintegration period for preceding years. This approach is complemented with the preliminary April aerial ice reconnaissance to develop knowledge of the general character of the ice. Utilizing the 30-day weather outlook issued by the U. S. Weather Bureau, ice conditions are projected for one month. Thereafter, the monthly charts are developed by assuming environmental conditions will approach normal during the disintegration period. Place names used in the outlook are shown in figure 1.

II. ANALYSIS OF ENVIRONMENTAL DATA

A. Oceanography

A comprehensive study was made of the oceanographic, meteorological, and climatological parameters affecting the ice characteristics. At the time of heat budget reversal, the thermal and saline structure of the sea was measured at selected oceanographic stations. Air temperatures expressed in cumulative degree days of freezing, snow cover, and radiational cooling were considered to determine heat loss and resultant ice growth. Dates of theoretical initial ice formation and theoretical ice thickness on 15 March based on these computations are presented in figure 2.

B. Climatology

Generally, the temperature regime of an area and the ice drift can be related to the mean sea level pressure pattern. This was done for the 6-month period prior to 15 March. The mean circulation during a considerable portion of the period was near normal. Winds in Baffin Bay north of 70N deviated from the normal easterly and northeasterly flow only from mid-February to mid-March when a dominant light southeasterly component was noted. Southward from 70N the wind pattern maintained a normal north to northwesterly flow to 60N and northwesterly flow south of 60N most of the winter. Winds along the entire East Greenland Coast south of Scoresby Sund were onshore from mid-January through mid-March owing to a southwestward displacement of the Icelandic low from its normal position. As a result, greater than normal onshore winds occurred south of 65N. North of 65N, normal onshore winds were observed.

The ice drift vectors as shown in figure 3, although slightly veered from normal, reflected the predominantly normal wind flow throughout the winter. It should be noted that these vectors are based on a six month average and that their magnitude along the Labrador Coast, though considerably stronger than in 1963, are near normal. In Baffin Bay, magnitudes approximated those observed in 1963. In addition, air temperature observations available for maritime weather stations fringing the area were used to compute degree-day information which was then used in conjunction with oceanographic station data and snow cover information to determine theoretical ice thickness. Analysis of this data indicates a considerable increase in thickness over last year. From Cartwright to Cape Chidley and along the Western Greenland Coast from Upernavik to the Sondre Stromfjord approaches, the ice was 10 to 20 inches thicker than last year. The mid-Baffin Bay pack from 68N to 73N exceeded last years thickness by more than 20 inches. The ice thickness in the Thule approaches northward from 75N was about the same as last year. The ice drift vectors indicate moderate to heavy ridging should have occurred along the Baffin Island and Labrador coasts with light to moderate ridging in eastern Baffin Bay.

III. PRELIMINARY SURVEY OF ICE CONDITIONS

Preliminary ice reconnaissance was flown during the period 5 through 8 April 1964. One P3A aircraft from Argentia, Newfoundland, surveyed the ice in the Labrador Sea, Davis Strait, and Baffin Bay. Project BIRDS EYE and Canadian reconnaissance supplemented ice data in these areas. Data taken on U. S. Navy flights from Keflavik, Iceland, on Project BIRDS EYE and on Danish reconnaissance flights were consolidated to show ice conditions along the east Greenland coast. Results of this survey are shown in figure 5.

A. Newfoundland and Labrador Coasts

Within the observed area southeast of Belle Isle, the pack consisted generally of 5 to 7 tenths concentration with areas of open water along the coast from Cape Bauld to Notre Dame Bay. The age was predominantly medium winter with secondary stages of young and thick winter ice. In the Strait of Belle Isle and the Gulf of St. Lawrence, the concentration was 7 to 10 tenths consisting of thick and medium winter in addition to slush and other forms of young ice.

In the area between Belle Isle and the Goose Bay approaches, close to very close ice extended 60 to 90 miles seaward with adjacent open pack concentrations extending 20 to 40 miles further seaward. All ice consisted chiefly of 80 percent thick winter and 20 percent young and medium winter ice. Fast ice was observed in Hamilton Inlet and in the waterways to Terrington Basin.

Northward from Hamilton Inlet to Cape Chidley, fast ice extended along the entire Labrador Coast, within all bays and coves, and generally seaward to the outer islands. Close to very close thick and medium winter ice with light ridging predominated throughout this area.

B. Baffin Bay

1. Baffin Island Coast - From the northern portion of Bylot Island to Cape Mercy, fast ice extended seaward 15 to 20 miles off the outer capes. In Cumberland Sound fast ice was observed along the northeast and southwest shores with areas of young ice in the central portion of the sound. Fast ice extended from the coast to the outer islands to Loks Land. Within Frobisher Bay, fast ice extended north and northwestward from the island chain in mid-bay. Much young ice was present in the central and southeastern portion of the bay.

Because of the remnant pack that remained from the 1963 season, about 10 percent young polar ice was observed in the western portion of Baffin Bay from 65N to 72N. The predominant concentration was close, thick winter ice. From Resolution Island to Bylot Island the ice was lightly hummocked, and moderate to heavy ridging was observed. Seaward from Cape Mercy an area of relative weakness was evident by the observation of 9 to 10 tenths coverage of 50 percent thick winter and 50 percent medium winter ice.

2. Central and Northern Baffin Bay

Very close ice, consisting mainly of 60 to 80 percent thick winter in the central and lower portion and 80 to 100 percent thick winter in the upper portion with secondary forms of young and medium winter ice, was observed. Moderate to heavy ridging prevailed on all ice. The north open water was evident in the west-central portion of northern Baffin Bay from about 74N to about 79N. Although the concentration was 9 to 10 tenths, it consisted chiefly of 80 percent young and medium winter ice north of 76N and 50 percent medium winter ice south of 76N. The remainder of the ice concentration consisted of thick winter floes.

3. West Greenland Coast

The fast ice boundary extended southward to a point immediately north of Itivdleq Fjord. North of 70N, very close concentrations of thick and medium winter ice with moderate to heavy ridging were observed in the offshore pack. In addition, a large open water lead was observed from Kap York to Kap Atholl. From 65N to 70N, concentrations ranged from 8 to 9 tenths. In the approaches to Sondre Stromfjord, concentrations were estimated to be less than 1 tenth. A 60-mile wide area of open pack ice was observed immediately north of Disko Island. Another significant feature of ice conditions was the greater than normal southeastward protrusion of the outer pack boundary which extended from a point on the west Greenland Coast south of Sondre Stromfjord southward to about 62.5N.

Fast ice in Itivdleq Fjord extended about 10 miles west of the site to 53.2W. Further westward, less than one tenth concentration consisting of small cakes was observed along the north shore and 8 tenths thick winter ice was observed along the south shore of the fjord.

Fast ice was observed throughout most of Sondre Stromfjord except at the entrance and a small area northeast of Simiutak Island. The ice in the fjord to Kap Look appeared to be weak owing to the many cracks and areas of medium winter ice observed. North of Kap Look, the fast ice appeared more formidable than seaward and contained only a few cracks.

C. East Greenland

From 65N to 71.5N, 8 to 9 tenths of predominantly polar and thick winter ice was observed. Along the outer pack boundary, areas of open to close pack ice were observed. The outer pack boundary extended

seaward about 40 miles at 65N to about 120 miles at 70N. Owing to undercast from 63N to 65N, only the radar boundary was reported. From 61N to 63N Danish reconnaissance observed open to close pack ice; south of 61N and around the southern tip of Greenland very open to open pack ice was observed. This ice was primarily storis (remnants of fused pressure ridges of polar ice drifting southward from the Arctic Ocean).

IV. OUTLOOK

A. General

Ice conditions determined by environmental considerations and observed by preliminary reconnaissance were somewhat similar to those observed in 1959 in the Labrador Sea. Conditions in Baffin Bay were anomalous as a result of relatively extensive amounts of young polar ice. With respect to monthly mean pressure patterns, a similarity exists between the prognostic mean sea level pressure chart for mid-April to mid-May and the observed pressure patterns for the same period for 1958 and 1959. As of 25 April the mean winds are tending toward those observed in 1959. Accordingly, the prognostic ice conditions for mid-May through mid-August, shown in figures 6 through 9, indicate nearer to normal conditions, such as observed in 1959, than the very anomalous conditions observed in 1958. Predicted opening dates are listed in Table 1.

TABLE 1

OPENING DATES FOR HARBORS

Harbor	Concentration in Approaches Less Than 8/10 and Fast Ice, if any, in Harbor Well Weakened	Concentration in Approaches 1/10 or Less
Itivdleq	10 May	15 May
Sondre Stromfjord	2 June	5 June
Goose Bay	8 June	22 June
Thule	12 July	24 July
Kulusuk	10 July	10 August

1. Newfoundland - Labrador Sea

By mid-May in the area south of Hamilton Inlet, the ice should consist of mostly very open and open pack. Concentrations are expected to remain off the Newfoundland Coast in response to southwesterly winds in that sector. In the approaches to Hamilton Inlet and along the remainder of the Labrador Coast, southwestward drift is expected to keep the close pack, dominant in that area, adjacent to a narrow band of fast ice.

From mid-May to mid-June, incursions of ice from the north are expected to keep patches of very open pack off the Northern Newfoundland Coast until about 10 June when final dissipation of ice in that area is expected. In the approaches to Goose Bay, close pack is expected until about 8 June; and by mid-June the last remnants of open pack are expected. Along the remainder of the Labrador Coast, dominant southwestward drift is expected throughout the period to result in close ice containing young polar floes lying adjacent to disintegrating and weakening fast ice. By 22 June the approaches to Goose Bay should be open to unescorted shipping although an occasional patch of very open pack may still be in the area.

2. Hudson Strait and Baffin Island Coast

By mid-May, close pack ice should predominate with fast ice in all bays and inlets. However, areas of very open pack should be present in Hudson Strait southeast of Big Island and along the northern coasts of Frobisher Bay and Cumberland Sound. Owing to the relatively extensive amounts of young polar ice observed adjacent to the Baffin Island Coast during the early reconnaissance and anticipated onshore drift, close pack ice is expected to dominate to the end of June. By mid-June, however, sea ice in the entrances to Hudson Strait and along the Baffin Island Coast northward of 72N is expected to show increased areas of open and very open pack.

By mid-July, the pack in Hudson Strait and Ungava Bay is expected to diminish considerably due to melting and eastward evacuation. From Cape Adair to Cape Dyer, a discontinuous, very open pack lead adjacent to weakening fast ice is expected. However, offshore in that area and southward to Loks Land, formidable close ice, containing many young polar floes, is expected to remain in conjunction with retarded southward drift.

By mid-August, the amount of ice in Baffin Bay is expected to be greater than normal and extend northward of 74N. Southward of Cape Dyer normal amounts are expected. However, slow disintegration of much of the remaining ice is anticipated, particularly south of 69N owing to relative increasing amounts of young polar ice.

3. Central and Northern Baffin Bay

By mid-May, the North Open Water should be in evidence in the form of a very open and open pack area in Smith Sound and an open pack area from 76N to 77N adjacent to fast ice along Ellesmere Island. By mid-June, rapid enlargement is expected owing to disintegration of the dominant young and medium winter ice observed during the early reconnaissance. Very open pack concentrations or less are expected to extend to Bylot Island, while much of the remainder of the area should be covered with close pack.

By mid-July, a southward enlargement of the North Open Water along northern Baffin Island and widening of the West Greenland lead should result in the formation of the characteristic close ice tongue in the central portion of Baffin Bay. The seasonal southward retreat of the tongue is expected to proceed slowly, however, owing to replenishment of the disintegrating pack by anticipated light southeasterly winds. By mid-August, very open pack extending northward from the central Baffin Bay pack is expected to remain north of 74N.

4. West Greenland Coast

Northward advection of relatively warm water from the Irminger Current, in conjunction with a slow northwestward ice drift, indicates the West Greenland lead development should be accelerated throughout the disintegration season. By mid-May an ice-free lead is expected to extend to 72N, and by mid-June to reach 74N. However, northwestward drift of ice in Melville Bugt is expected to keep the Northabout and Middle Passage routes to Thule congested with close ice until 12 July. Unescorted entry is not expected until 24 July.

5. East Greenland Coast

Onshore winds are expected to retard the southward ice advection and keep close ice adjacent to the coast throughout May and June. By mid-July, melting and net efflux of ice from the Kulusuk area should narrow the pack south of 65N and permit escorted shipping to that site by 10 July. Very open pack should continue to drift into the Kulusuk approaches until about 10 August, when unescorted entry is expected.

B. Harbors

1. Goose Bay

The first signs of breakup in the waterways between Hamilton Inlet and Terrington Basin were observed during the early reconnaissance in the form of open water areas in The Narrows and at the mouths of the larger rivers. Based on the near-normal frost degree day accumulations to 15 March, breakup of the fast ice in Terrington Basin, Goose Bay, as well as development of an open water area along the north shore of Lake Melville is expected about 25 May. By 30 May all ice in Lake Melville, Goose Bay, and Terrington Basin is expected to have disintegrated.

2. Itivdleq

Investigation of limited data concerning the date of fast ice breakup in Itivdleq Fjord indicated a wide variance that probably is related to many factors including tidal action, ice thickness, air temperature, and wind force. In the absence of anomalous strong winds and warm temperatures, the fast ice in the site approaches is expected to breakup by 10 May. Unescorted shipping should be possible by 15 May.

3. Sondre Stromfjord

By 15 May, all ice seaward of Kap Look is expected to have discharged. Based upon the number of frost degree days accumulated this winter, the ice in the fjord north of Kap Look should attain a maximum thickness of about 40 to 42 inches which is about 4 to 6 inches less than normal. Accordingly, fast ice breakup in the anchorage area is expected to occur slightly ahead of normal on about 28 May and the remainder of the fast ice seaward to Kap Look should breakup about 2 June. Final clearing of all ice is expected by 5 June.

4. Thule

Fast ice in North Star Bugt is expected to become well puddled by 30 June and to breakup earlier than normal on about 5 July owing to less than normal frost degree days accumulated during the winter season. In the absence of a discharge of the broken fast ice by offshore winds, the bay is expected to become essentially ice free by 15 July.

5. Kulusuk

Constant southward advection of storis ice and onshore drift is expected to negate the less than normal frost degree days accumulated throughout the winter season and keep the approaches congested with close ice until the near-normal opening date of 10 July when escorted shipping should be possible. Very open and open pack should continue to drift southward past Kulusuk until about 10 August when unescorted shipping may be expected.

V. GENERAL INFORMATION

A. Brief on Icebergs

Iceberg frequency and major drift are shown graphically in figure 10.

The glaciers of Greenland are the source of almost all bergs encountered in the area. Because of their great draft, bergs tend to be more responsive to deep currents than to surface winds. Accordingly, nearly all icebergs sighted south of 65°N along West Greenland originate from glaciers on East Greenland and tend to move southward along the southeastern coast of Greenland, northward along West Greenland, and southward along the Baffin Island and Labrador coasts. The distance covered by bergs drifting in the latter manner from the southwestern coast of Greenland to southern Newfoundland is about 1,800 miles and requires about 3 years to traverse. However, most bergs disintegrate or are trapped in the many indentations along the Baffin Island and Labrador coasts, so that only about 1 in 20 bergs survive the journey.

Owing to offshore currents, the coastal area between Godthaab and Holsteinsborg is relatively free of icebergs. The heaviest concentration of bergs north of Holsteinsborg and Egedesminde occurs in the vicinity of Disko Bugt, especially during June and July. Accordingly, many of the bergs in Baffin Bay and in the western Labrador Sea are believed to originate from this area.

B. Freezeup Information

Freezeup information including dates of initial ice formation, as well as an average of all the dates at specific sites for a number of individual years, is presented in figure 11. The freezeup information applies to the immediate harbor or coastal sector of the site indicated. Although initial ice generally does not hamper shipping, the dates provided give some indication as to the beginning of freezeup in various areas and of the variability that exists from year to year.

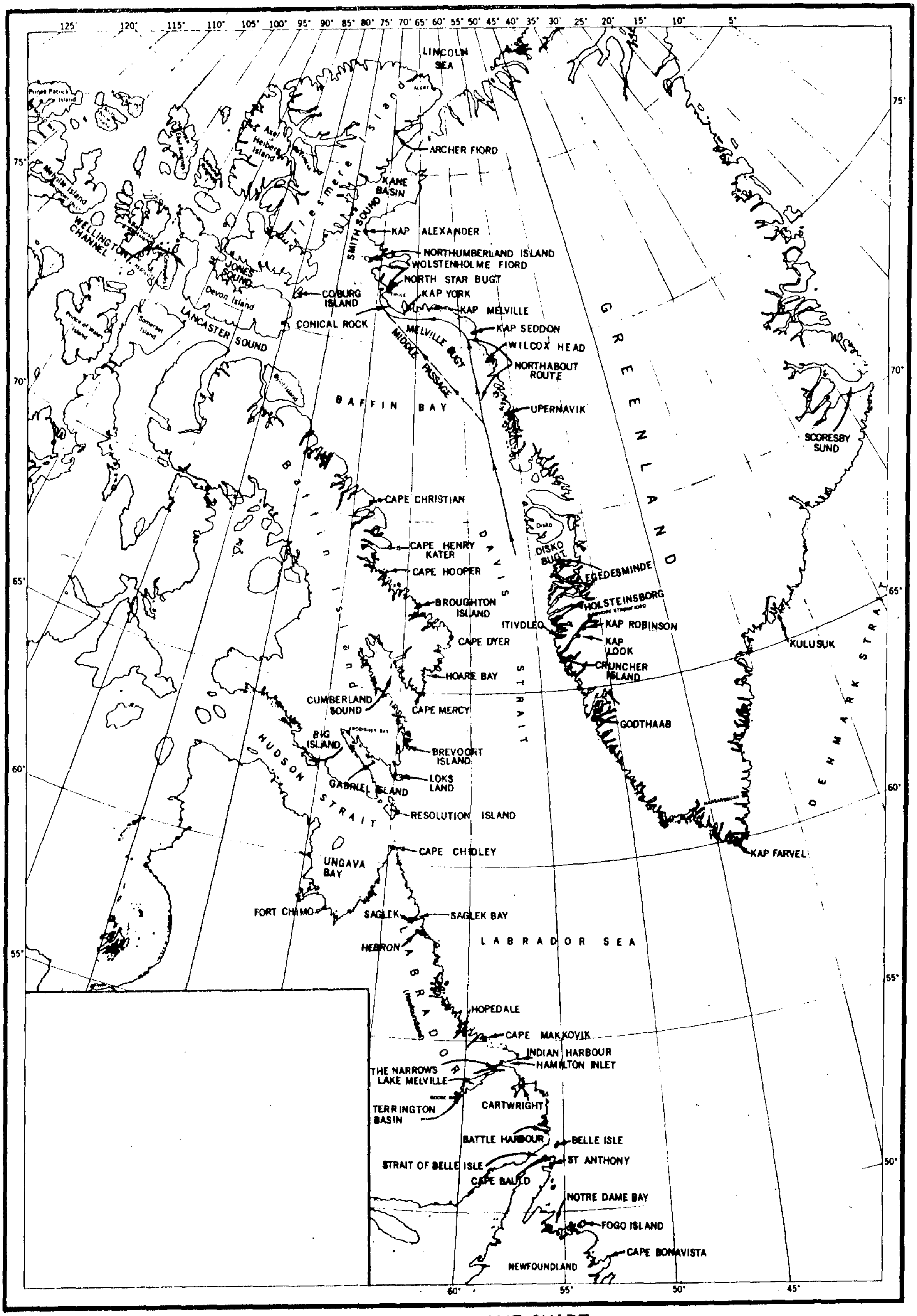

FIGURE I PLACE NAME CHART

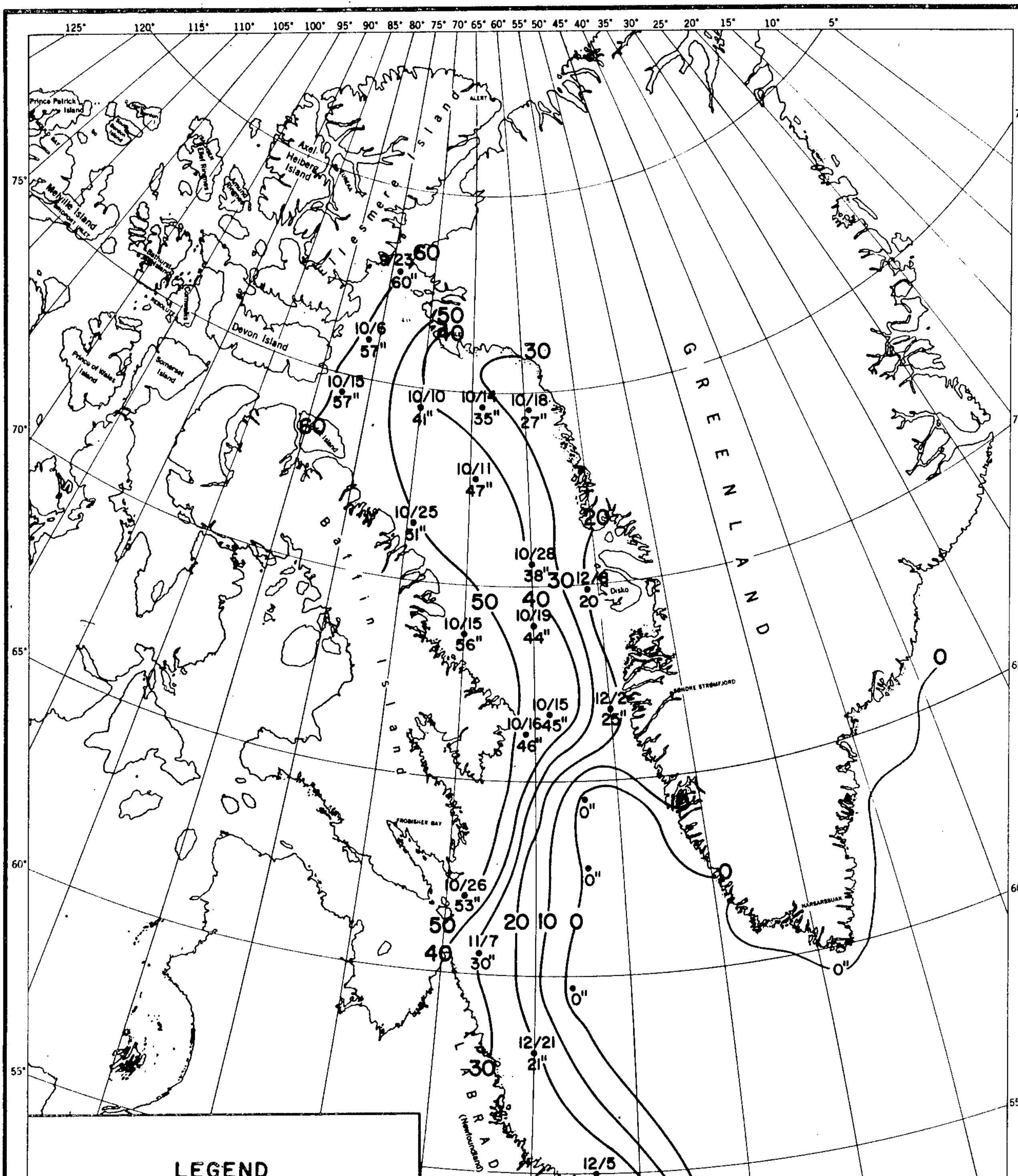

FIGURE 2 COMPUTED ICE THICKNESS FOR UNDISTURBED ICE ON 15 MARCH 1964

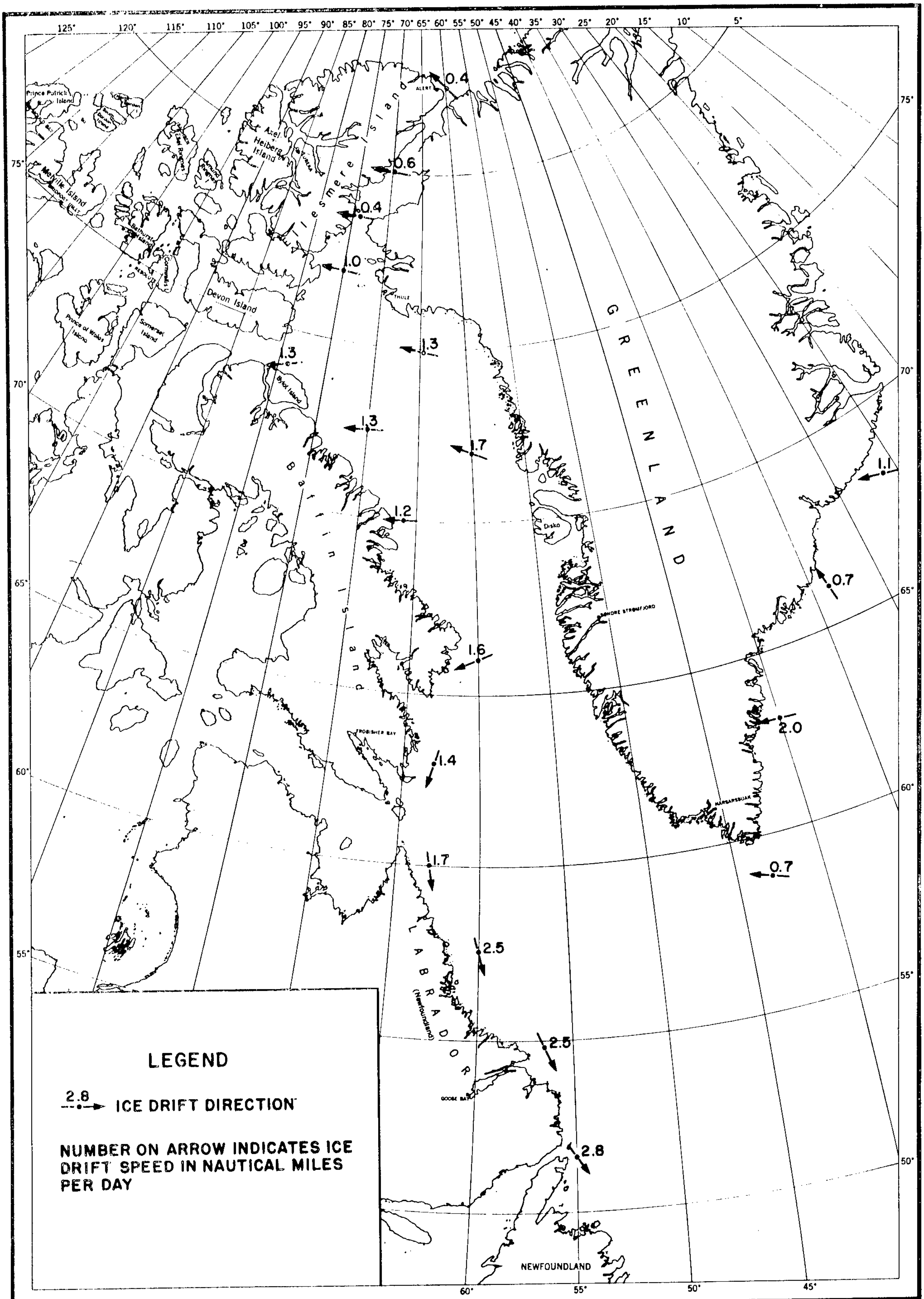

FIGURE 3 COMPUTED MEAN ICE DRIFT 15 OCTOBER 1963 THROUGH 15 MARCH 1964

TOTAL CONCENTRATION

ICE FREE

0.1
(OPEN WATER)

0.1 THRU 0.3
(VERY OPEN PACK)

0.4 THRU 0.6
(OPEN PACK)

0.7 THRU 0.9
(CLOSE PACK)

1.0 (FAST OR
VERY CLOSE PACK)

COVERAGE BY SIZE

$$\frac{Cn}{n_1\ n_2\ n_3}$$

n_1 = tenths of slush, brash, and cakes

n_2 = tenths of small and medium floes

n_3 = tenths of big and vast floes

EXAMPLE: $\frac{7}{241}$

7 - TOTAL CONCENTRATION
2 - TENTHS ICE LESS THAN 30' ACROSS
4 - TENTHS OF FLOES (30'-3000')
1 - TENTHS OF FLOES (>3000')

BOUNDARY

OBSERVED

- - - - - ESTIMATED

. . . . . LIMIT OF OBSERVED DATA

STAGE OF DEVELOPMENT

$$\frac{A}{\%\text{PREDOMINANT, }\%\text{SECONDARY}}$$

IC = Crystals
SL = Slush
IR = Ice Rind
PK = Pancake
Y = Young
MW = Medium Winter
TW = Thick Winter
WT = Winter
PL = Polar
YP = Young Polar
AP = Arctic Pack

EXAMPLE: $\frac{A}{7MW3SL}$

A = Stage of Development
7 = 70% Medium Winter
3 = 30% Slush

THICKNESS OF ICE AND SNOW

$\frac{T}{n}$ = Ice Thickness (inches)

$\frac{SD}{n}$ = Snow Depth (inches)

PHENOMENA SYMBOLS

CRACK

POLYNYA

LEAD

(n) ICEBERGS

(n) BERGY BITS & GROWLERS

(n) = number in area

TOPOGRAPHY

$\frac{ΛΛ}{(n)}$ RAFTED

$\frac{ΛΛΛ}{(n)}$ RIDGED

$\frac{∩∩}{(n)}$ HUMMOCKED

EXAMPLE: $\frac{ΛΛ}{(n)}$ - $\frac{ΛΛΛ}{(n)}$ +

+ After symbol indicates average height 10 ft or greater

- After symbol indicates average height less than 10 ft

(n) tenths coverage in area

STAGE OF MELTING

$$\frac{PD}{(n) + (n)\ F}$$

PD = Puddling - tenths value entered under the "PD" unless frozen or rotten

EXAMPLE: $\frac{PD}{3}$ = 3 tenths puddling

$\frac{PD}{3F}$ = 3 tenths frozen puddles

(n) = tenths coverage in area

(n) F = tenths coverage in area, frozen

$\frac{TH}{n}$ = Thaw Holes - same entry procedure as above

$\frac{S}{n}$ = Snow cover in tenths

UNDERCAST

Limit

FIGURE 4 KEY TO ICE SYMBOLS

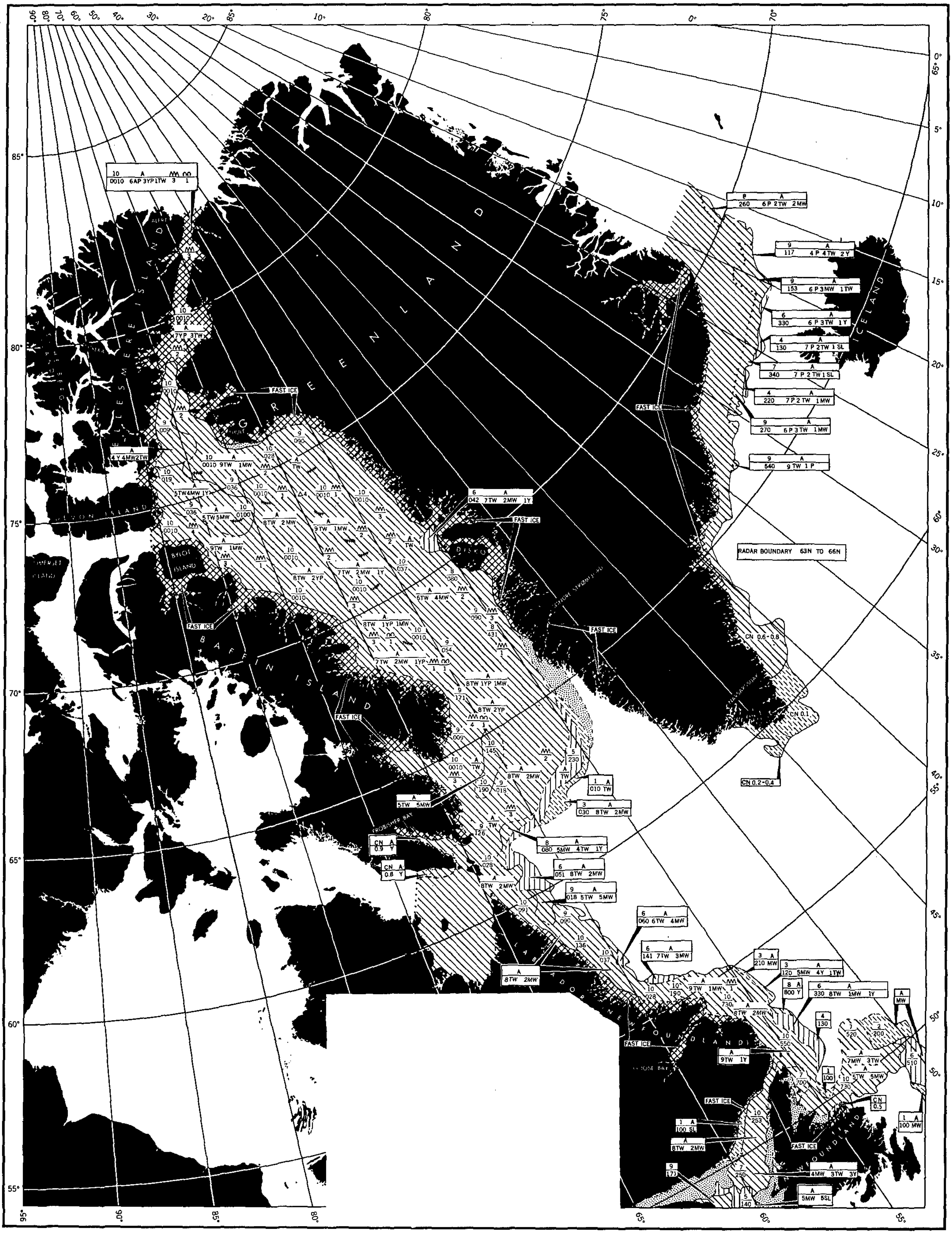

FIGURE 5 OBSERVED ICE CONDITIONS 5-8 APRIL 1964

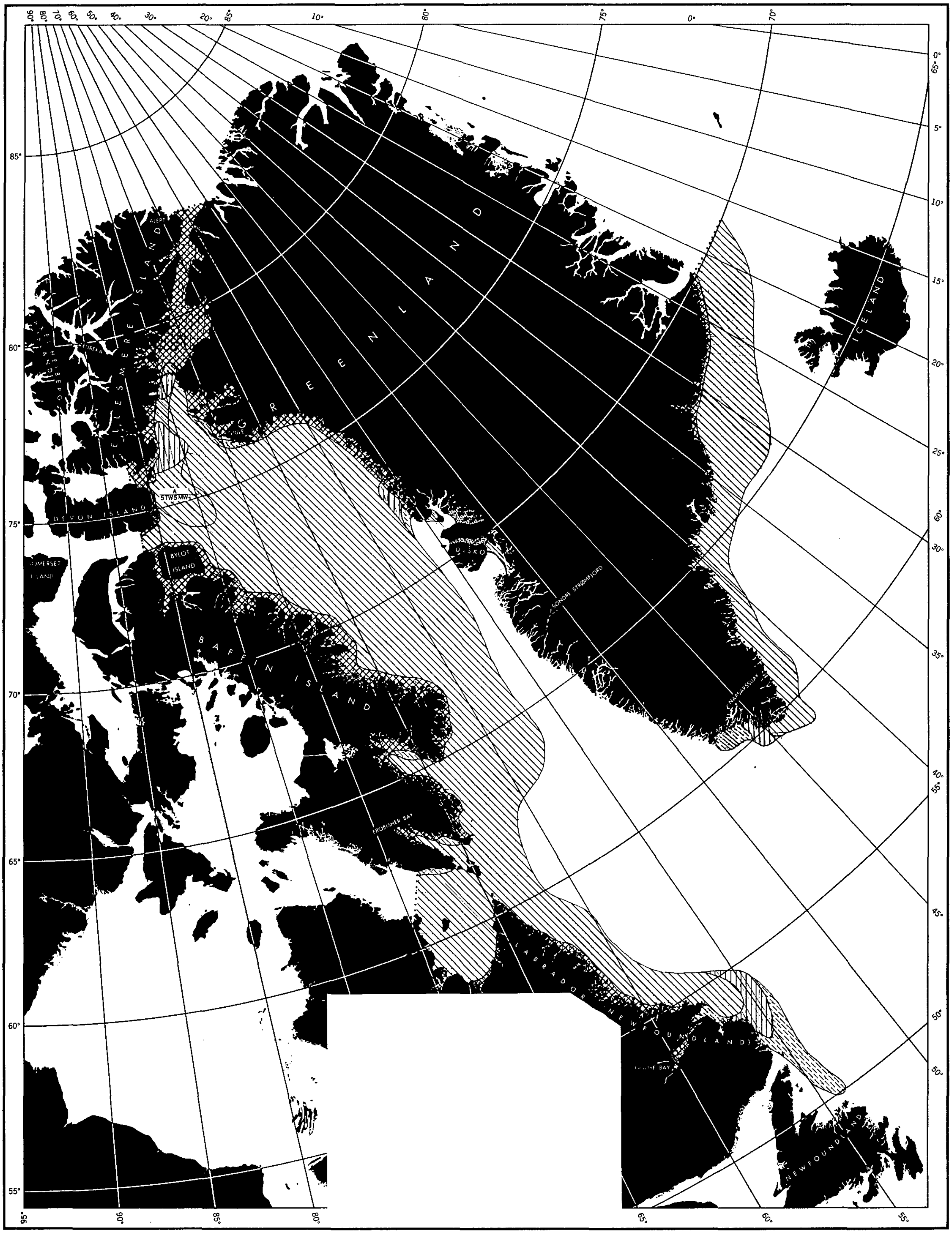

FIGURE 6 PROGNOSTIC ICE CHART MID-MAY 1964

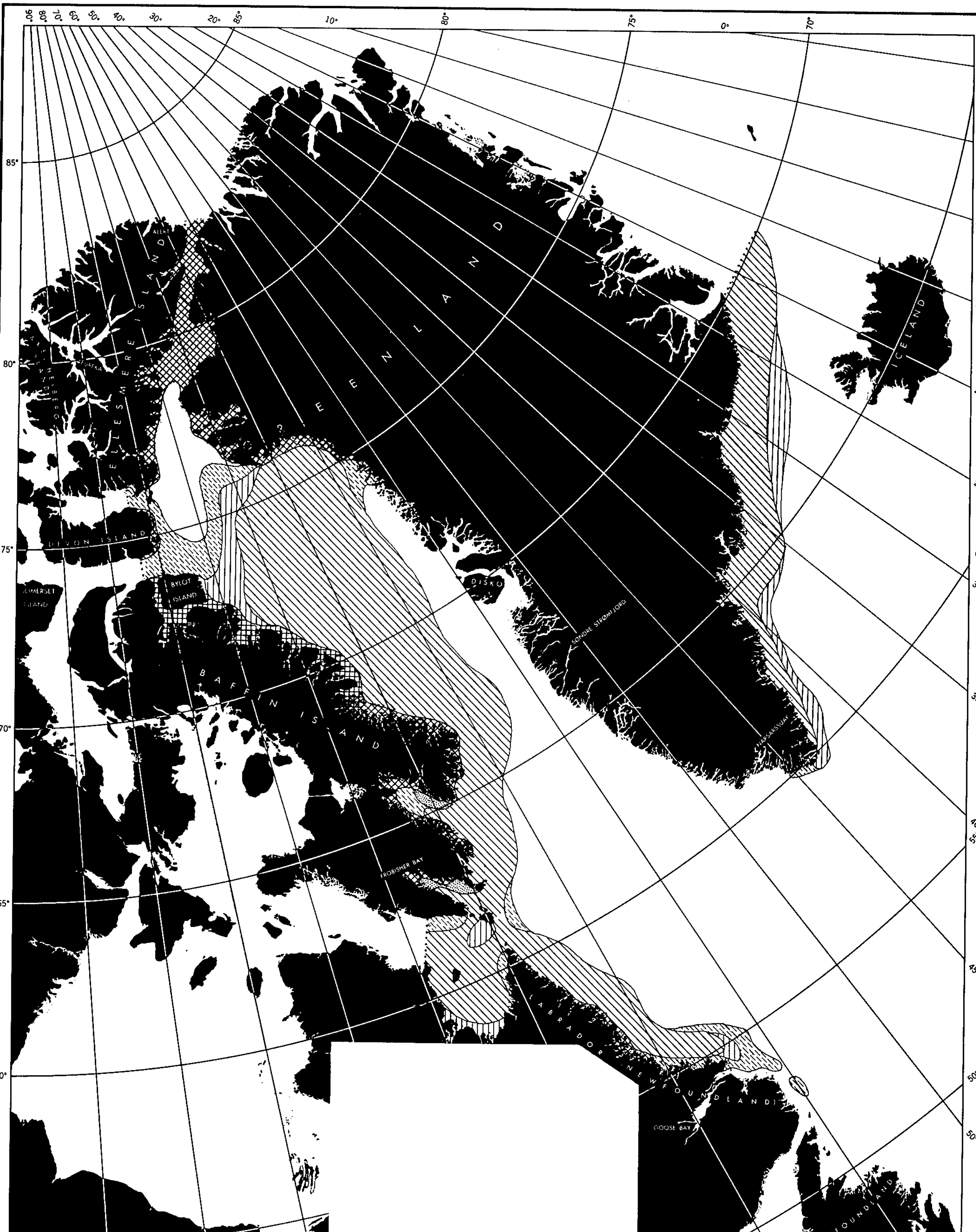

FIGURE 7 PROGNOSTIC ICE CHART MID-JUNE 1964

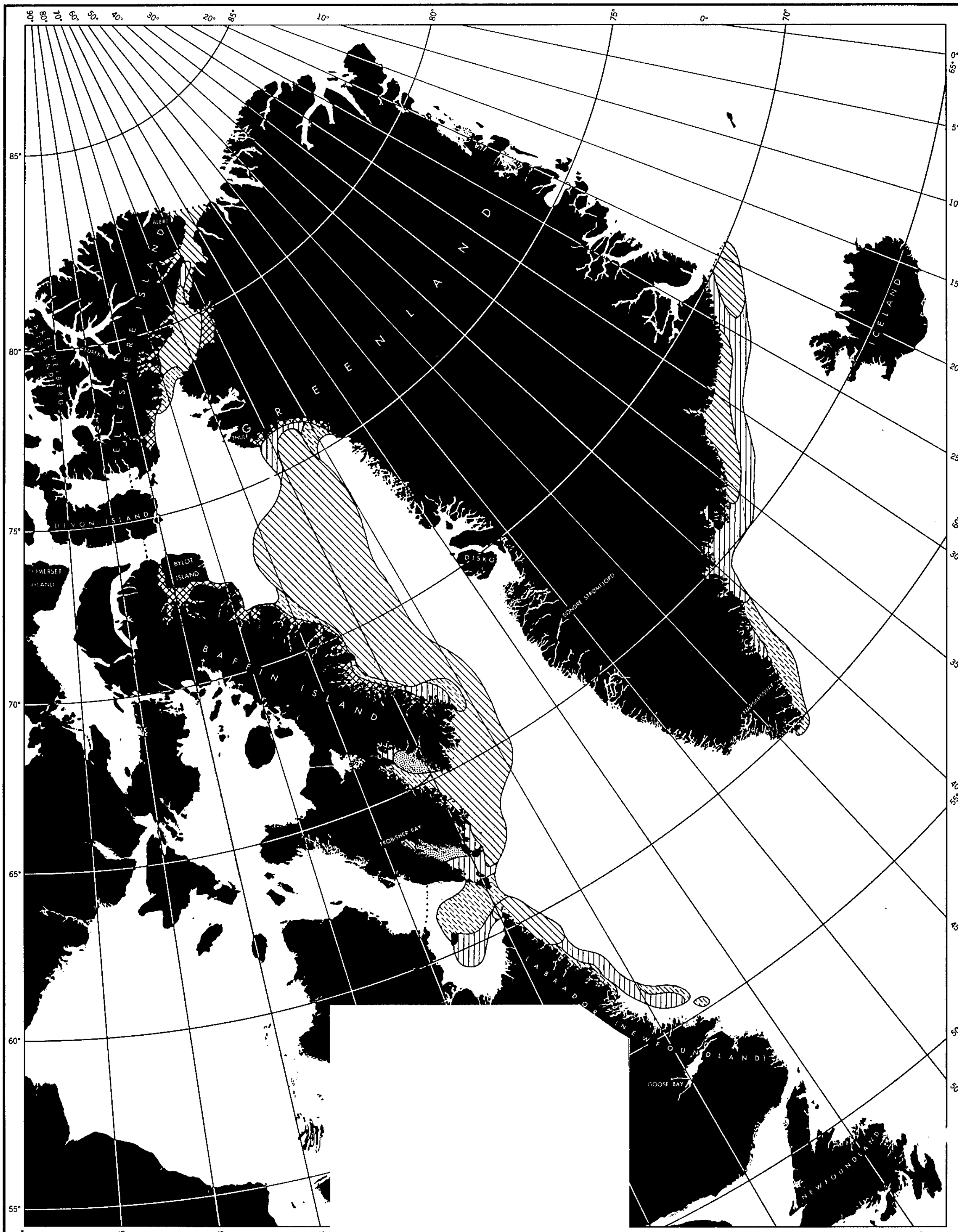

FIGURE 8 PROGNOSTIC ICE CHART MID-JULY 1964

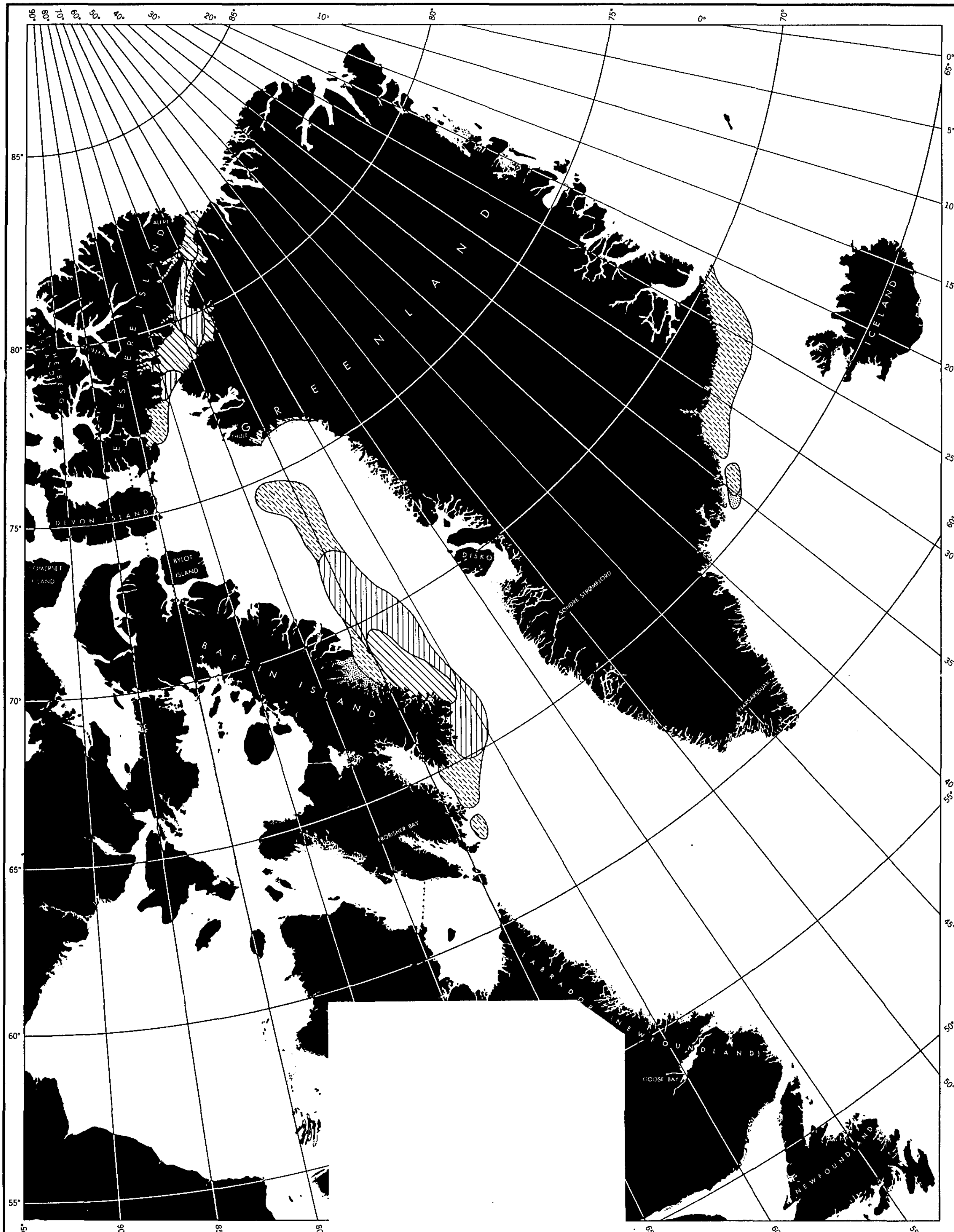

FIGURE 9 PROGNOSTIC ICE CHART MID-AUGUST 1964

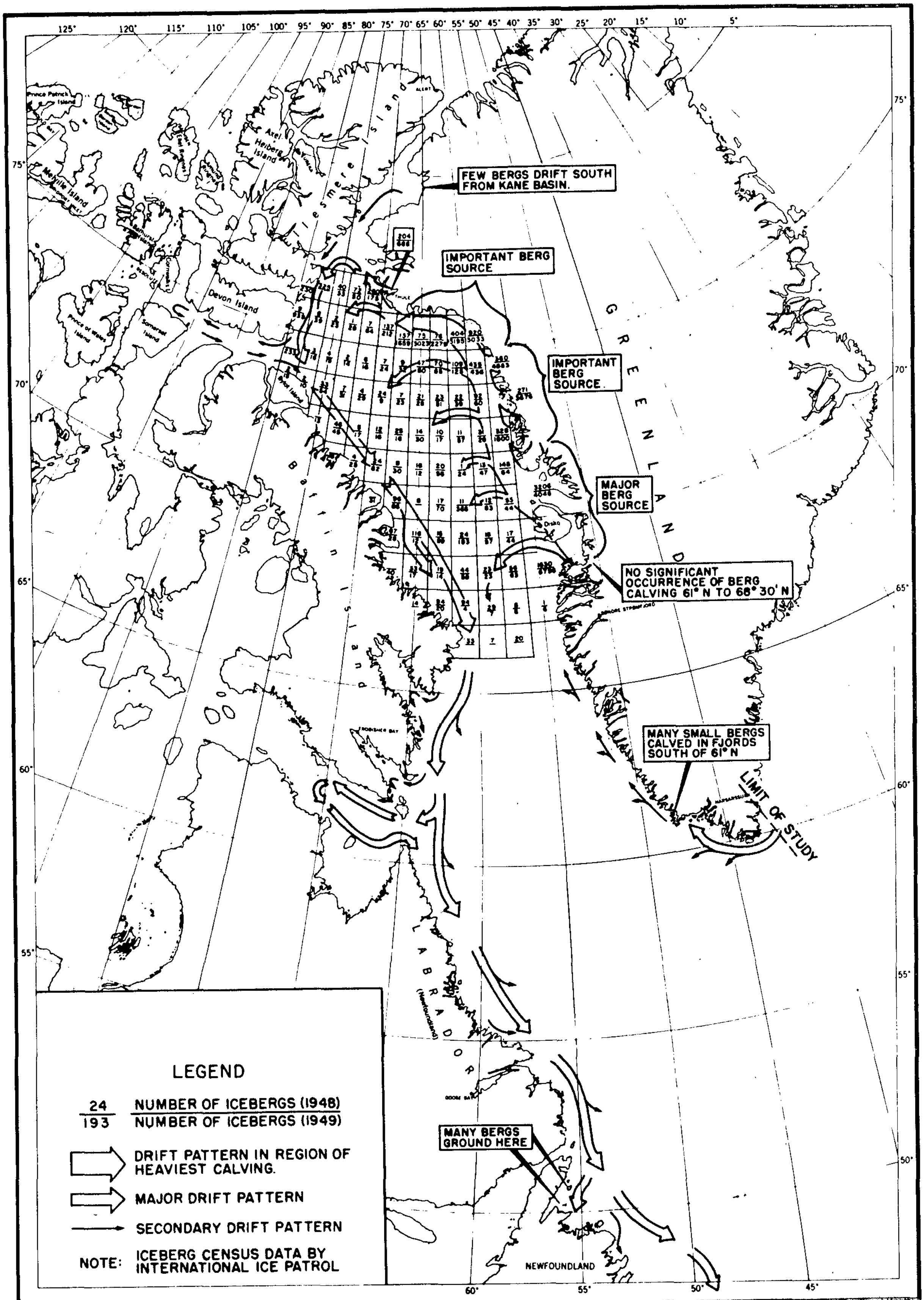

FIGURE 10 ICEBERG CENSUS DATA AND GENERAL DRIFT PATTERNS

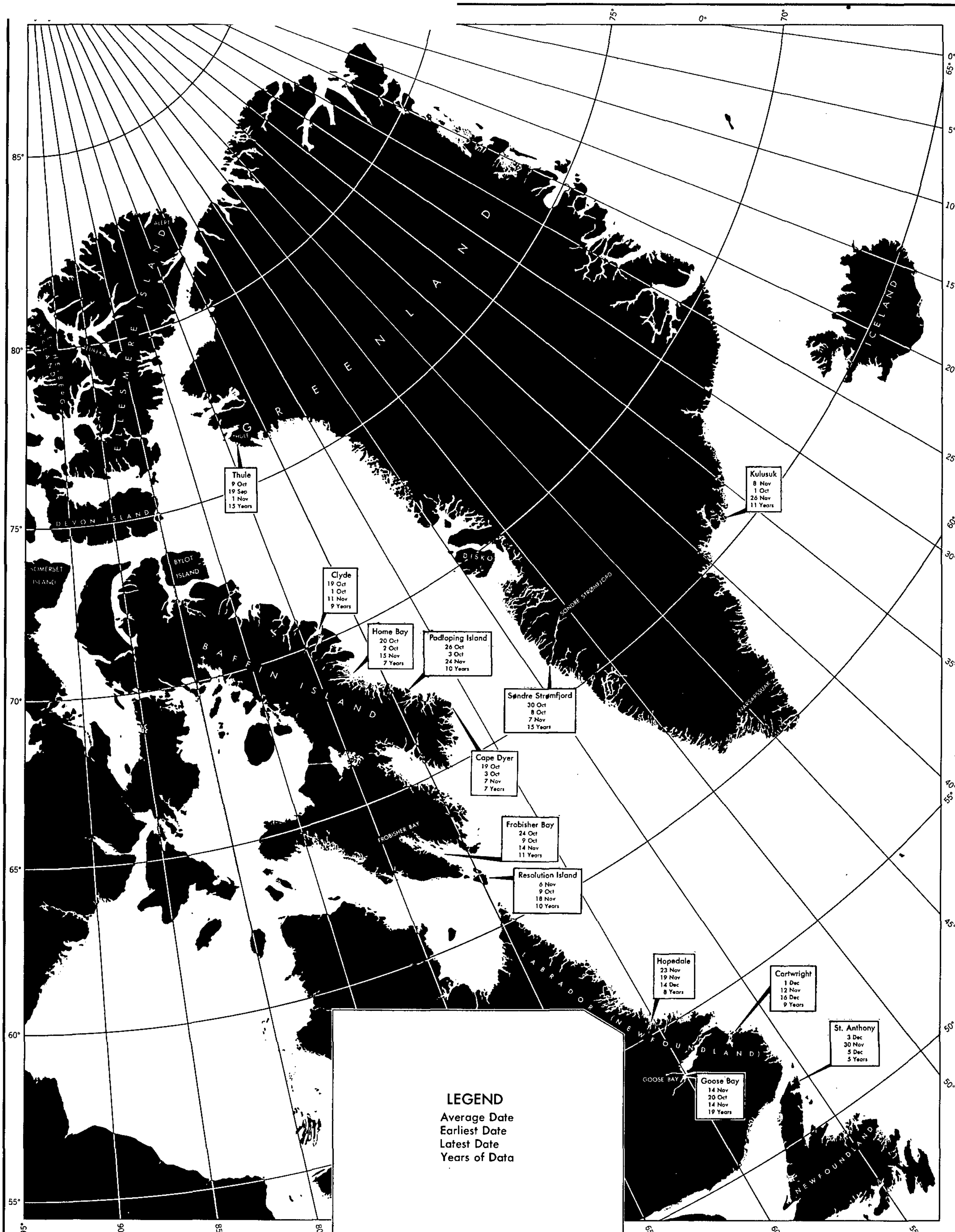

FIGURE 11 DATES OF INITIAL FREEZEUP

U.S. Naval Oceanographic Office
LONG-RANGE ICE OUTLOOK, EASTERN ARCTIC (1964). April 1964. 9 p. text and 11 figures. SP-60(64) (Formerly H.O. Misc. 15869-26)

An analysis of oceanographic and climatic data for forecasting ice growth during the winter 1963-64 and the climatic outlook for the 1964 arctic shipping season are included. Results of a preliminary survey of sea-ice conditions in the Labrador Sea, Davis Strait, Denmark Strait, and Baffin Bay are presented. A series of charts shows monthly prognostic sea-ice conditions from mid-May through mid-August 1964. Opening dates and harbor freezing information are included.

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2. Ice Distribution, Arctic
3. Climate, Arctic

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